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TRITON Nonionic Surfactant X-100

PRODUCT DESCRIPTION

TRITON X-100 is a high-purity, water-soluble, liquid, nonionic surfactant that has come to be recognized as the performance standard among similar products. It is an octylphenol ethoxylate consisting of nine to 10 moles of ethylene oxide and is supplied as a 100-percent active product. The purity of TRITON X-100 makes it desirable for uses where a refined grade of surfactant is required.

SPECIAL FEATURES

- Excellent compatibility with anionic surfactants
- Excellent wetting ability
- Excellent detergency and oil removal properties

TYPICAL PHYSICAL PROPERTIES

Actives Content, wt%	100
Appearance	Clear liquid
Color, APHA	100
Viscosity at 25°C, cP	240
Pour Point, °C (°F)	7 (45)
Specific Gravity at 25/25°C	1.07
pH, 5% aqueous solution	6
Cloud Point, 1% aqueous solution, °C	65
Density at 25°C, lb/gal	8.9
Flash Point, Tag Open Cup, °F	>300
HLB Value	13.5

PERFORMANCE PROPERTIES

TRITON X-100 has performance properties similar to those of TRITON X-100 which are described below.

Solubility and Compatibility

TRITON X-100 is soluble at 25°C in all proportions in water, toluene, xylene, trichloroethylene, ethylene glycol, ethyl ether, ethyl alcohol, isopropyl alcohol, ethylene dichloride, and many other solvents. TRITON X-100 is insoluble in kerosene, mineral spirits, and VM&P naphtha, unless a coupling agent is used. Oleic acid is an effective coupling agent in systems based on aliphatic solvents. Solutions containing up to five-percent TRITON X-100 in 40-percent phosphoric acid or 30-percent hydrochloric acid are stable for at least 48 hours at room temperature.

TRITON X-100 is compatible with anionic, cationic, and nonionic surfactants. Like other alkylaryl polyether alcohol, this surfactant will discolor on dry caustic and anhydrous metasilicate. However, TRITON X-100 can be used in formulations containing moderate quantities of these alkalis with sufficient stability. It is completely stable in liquid formulations containing sodium hydroxide, showing no change in color or physical properties, and in the presence of mild, alkaline builders normally used in the preparation on metal cleaners and cleaning compounds.

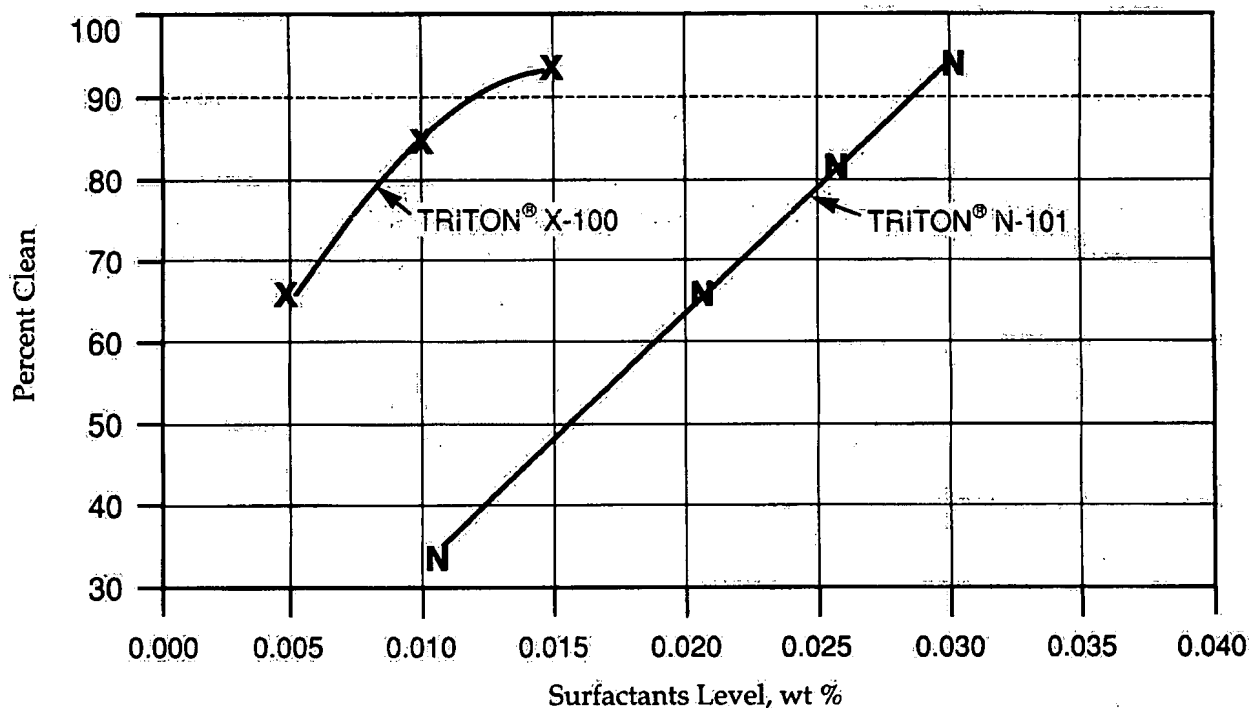
Detergency

TRITON X-100 is a highly effective detergent. It is effective in textile cleaning applications and is used in "built" formulations designed for home and industrial laundering.

Hard-Surface Cleaning

TRITON X-100 offers exceptional performance in hard-surface cleaning applications. In a metal cleaning application, TRITON X-100 was compared to TRITON N-101. For this test, steel test panels were soiled with a heavy primary motor oil (Brightstock) and cleaned in a bath with a heavy-duty, alkaline detergent containing TRITON X-100 or TRITON N-101 surfactants. Figure 1 shows the percent cleaning obtained versus surfactant concentration. TRITON X-100 surfactant delivers 90 percent cleaning efficiency at less than half the concentration required by TRITON N-101 to reach the same cleaning efficiency.

Figure 1 • Metal Cleaning Performance of TRITON X-100 vs. TRITON N-101



(1) Brightatock Oil, 3% Builder, 80°C, 5 min cleaning

Foaming Properties

TRITON X-100 has moderate foaming properties. Where higher foaming is important, TRITON X-100 can be used in combination with certain high-foaming, anionic, surfactant, such as TRITON X-301 (an alkylaryl polyether sulfate), alkyl sulfates, alkylaryl sulfonates, alkyl ether sulfates, or fatty acid amide condensates.

Table 1 • Ross-Miles Foam Heights

TRITON Surfactant	Concentration, wt%	Foam Height, mm	
		Initial	5min
X-100	1.0	228	23
	0.1	110	25
	0.01	20	20
X-100:X-301 at 2:1			
Ratio,solids basis	0.1	165	95

Surface Activity

TRITON X-100 exhibits good surface activity, as indicated by the lowering of the surface tension of water and the interfacial tensions between water and mineral oil. The data

presented in Table 2 were obtained with a Du Nouy Tensiometer.

Table 2 * Surface Activity of TRITON X-100

TRITON X-100 Concentration, wt%	Surface Tension, Dynes/cm	Interfacial Tension, Dynes/cm
1.0	30	1.0
0.1	30	2.5
0.01	31	10.0
0	72	52

Wetting

The Draves Wetting Test determines the concentration of wetting agent needed to sink a weighted cotton skein in an aqueous solution in a given period of time. The procedure is detailed in the Yearbook of the American Association of Textile Chemists and Colorists as Standard Test Method 17-52. Results for TRITON X-100 are given in Table 3.

Table 3 * Draves Wetting Test

Wetting Out Time, sec	TRITON X-100 Concentration, wt%
10	0.092
25	0.048
50	0.028

Viscosity

The data in Table 3 show the viscosity of aqueous systems containing TRITON X-100 at various concentrations and temperatures.

Table 3 * Viscosity of TRITON X-100 Aqueous Solutions

Temperature, °C	Viscosity, cP					
	Surfactant Concentration, wt %					
	10	30	50	70	90	100
25	2	80	Gel	530	280	270
50	3	40	110	100	80	80
25 (1M NaCl)	7	150	640	470	260	-
25 (1M CaCl ₂)	7	240	101	560	310	-

Increased viscosity and gel formation at concentrations around 50 percent are probably due to interference with the flow that results from hydration of the oxyethylene ether linkages in the aggregates. The effect of increasing temperature or salt concentration, or both, is to produce partial dehydration of these linkages and to allow freer flow.

Thermal Stability

Thermogravimetric analysis has been used to determine the thermal stability of TRITON X-100, since it is sometimes used for high-temperature applications. Weight losses were determined at a programmed heating rate of 10°C /min, starting at 35°C under conditions of air or an inert (N₂) atmosphere.

Table 5 * Thermogravimetric Analysis of TRITON X-100

Weight Loss, %	Temperature, °C	
	Air	N ₂
1	221	210
10	291	310
50	347	380

Additional testing with thermogravimetric analysis (TGA) in conjunction with Fourier Transform Infrared Spectroscopy (TGA-FTIR) revealed that under inert (N₂) condition, observed weight loss is due to product volatilization. Under an air atmosphere, oxidative by

products are chiefly responsible for observed weight loss.

APPLICATIONS

TRITON X-100 improves the performance of specialty formulations for the home and industry.

The exceptional hard-surface detergency of TRITON X-100 makes it well suited as a base ingredient in floor cleaners, detergent sanitizers, and metal cleaners. Because of its rapid wetting properties and good detergency on fabrics, TRITON X-100 is recommended for laundry products and textile mill operations.

TRITON X-100 can be added to powdered products to reduce dust and to improve detergency; concentrations as low as 0.25 percent are effective. Powdered formulations, containing up to 10-percent TRITON, can retain their free-flowing characteristics. Specific recommendations for adding liquid surface-active agents to powdered preparations are available upon request. TRITON X-100 can also be used in pesticide formulations that are either applied to growing crops or used in post-harvest treatments [40 CFR 180.1001 (c,e)].